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ABSTRACT

This study attempted to determine if performance on Piagetian tasks can be predicted from Stanford-Binet mental age or IQ. Subjects were 143 children of bright, average, and retarded abilities as measured by performance on the Stanford-Binet Intelligence Test. Bright and average children were chronologically aged five to seven years; retarded children were mentally aged five to seven and chronologically aged six to twelve. Fifteen Piaget-type tasks were individually administered in three sessions. Results showed that (1) children of higher IQ develop through Piagetian stages faster than children of lower IQ, and (2) prior to the period of concrete operations, high-IQ children tend to think in a more preoperational way than older children of the same mental age but lower IQ. Conclusions were that psychometric tests and Piagetian tasks seem to reflect two kinds of intelligence, and that experience is an important factor in the development of Piagetian intelligence. For another analysis of these data, see SE 016 418. (DT)

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The Two Intelligences of Bright, Average, and Retarded Children[1]

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Two entirely different conceptions of intelligence have given us two very different ways of assessing it. The psychometric conception gives us tests of intelligence which are based on inter-individual differences. In contrast, Piaget's developmental theory gives us tests of intelligence based on intraindividual differences from infancy to adulthood.

Psychometric tests of intelligence are, of course, age-developmental to some degree since items are selected in terms of age-normative performance and since mental age also refers to age norms. Therefore, the following question arises: Are psychometric and Piagetian tests measuring the same developmental changes, but in different ways? This study is concerned with whether psychometric tests and Piagetian tasks measure the same intelligence. The hypothesis is that not only are the methods different, but also that the intelligence they measure is different.

Two approaches were used in exploring this hypothesis. The first approach was factor analytic and was reported elsewhere (DeVries, 1973). The second approach, reported here, supports the conclusion of the factor-analytic study. This approach is to compare the performance on Piaget-type tasks of children classified as bright, average, and retarded by psychometric tests.

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[1]Paper presented at the biennial meeting of the Society for Research in Child Development, Philadelphia, March 29, 1973. The author is indebted to Dr. Constance Kamii for her very helpful criticisms and suggestions on an earlier draft of this paper.

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This strategy involves, for example, getting answers to questions such as the following:

1. When chronological age is the same, do High-IQ children perform better on Piaget-type tasks than Average-IQ children?
2. When mental age is the same, do Higher-IQ children perform at the same level on Piaget-type tasks as older, lower-IQ children?

If the answers to all such questions are "yes," then we can conclude that Piagetian tasks and psychometric tests both measure the same intelligence and can be used interchangeably. If, on the other hand, any of these answers is "no," then we must re-examine the assumption that human intelligence is adequately assessed by psychometric methods. The basic question is: Can performance on Piagetian tasks be predicted from Stanford-Binet mental age or IQ?

Subjects

Ss were 143 white children, of bright, average, and retarded abilities (measured by performance on the Stanford-Binet Intelligence Test) enrolled in the public schools of Champaign, Illinois. Bright and average children were chronologically aged 5 to 7 years. Retarded Ss (including some pupils enrolled in the public schools of Urbana and Saint Joseph, Illinois) were mentally aged 5 to 7 years and chronologically aged 6 to 12 years. Table 1 shows the distribution and characteristics of the sample.

Procedure

Fifteen Piaget-type tests[1] were individually administered in three sessions totalling about two hours as follows:

Session 1: Guessing Game
Conservation of Mass
Sibling Egocentrism
Left-Right Perspective
Generic Identity
Class Inclusion

Session 2: Conservation of Number
Sex Identity
Conservation of Mass in the context of the ring-segment illusion (Jastrow effect)
Dream Interview
Conservation of Length

Session 3: Length Transitivity
Conservation of Liquid
Magic Interview
Object Sorting

Analysis

A Guttman scale was constructed for each of the Piaget-type tasks which met Green's (1956) statistical criterion of an Index of Consistency greater than .50. Each scale also met Kohlberg's (1967) criteria for developmental sequentiality. That is, mean scale scores increase with age, success on each scale item increases with age, and the sequence of items can be justified with a logical rationale based on Piaget's theory. All criteria were applied to each ability group separately, and the order of scale items was the same for each ability group on all tasks. Each S was assigned a scale score on each task, and these were used to obtain group means for each age-ability-sex group.

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[1] Tasks and scoring are described in detail in DeVries, Rheta, "Evaluation of Cognitive Development with Piaget-Type Tests: Study of Young Bright, Average, and Retarded Children," Final Report to Illinois Department of Program Development for Gifted Children, ERIC/ECE, Urbana, Illinois.

In order to find out whether groups similar on psychometric performance would also be similar on Piagetian task performance, and whether groups dissimilar on psychometric performance would also be dissimilar on Piagetian task performance, the following two kinds of group comparisons were made:

1. Groups of the same chronological age, but different mental age and IQ: Analysis of variance of Bright vs. Average groups.
2. Groups of the same mental age, but different chronological age and IQ:
   a. Analyses of variance of Average vs. Retarded groups;
   b. t-tests of differences between Bright 5's and Retarded 7's;
   c. t-tests of differences between Bright 5's and Average 6's;
   d. t-tests of differences between Bright 6's and Average 7's.

Results

Mean performance of bright, average, and retarded groups at ages 5, 6, and 7 years (chronological age for bright and average Ss, and mental age for retarded Ss) is presented graphically in Figure 1. Let us focus first on the comparison between bright and average children.

The first finding is not surprising. Psychometrically bright children outperform average children of the same chronological ages on all tests except Sorting (which doesn't differentiate at all among the groups). The IQ column in Table 2 shows that these differences are statistically significant for all tasks except Conservation of Mass, Left-Right Perspective, and Sorting. Therefore,

since High-I_q children thus consistently do better than Average-I_q children, the conclusion from this first comparison is that Piagetian tasks and the Stanford-Binet must measure the same intelligence.

The second comparison between average and retarded children also supports this conclusion. Table 3 indicates that when mental age is comparable, average and retarded children are not significantly different on 13 of the 15 tasks. Only on the Guessing Game does the average group prove superior to the retarded. On the Sex Identity task, however, the retarded group is superior to the average group. Therefore, since the Average-I_q and Low-I_q children of the same mental age perform similarly, the conclusion from the second comparison is that the Stanford-Binet and Piagetian tasks must reflect the same intelligence.

Contradictions to this neat conclusion arise, however, when we further compare High-I_q groups with other groups of the same mental age. Table 4 shows the results of these comparisons. (Note that Bright 5's and 6's are compared with older groups lower in I_q.)

In the third comparison between Bright 5's (mean MA=7-2 years) and Retarded 7's (mean MA=7-6 years), we find the retarded group superior to the bright group on eight tasks (Conservation of Mass, Length, Liquid, Sex Identity, Generic Identity, Magic, Dream, and Left-Right Perspective). The bright group is higher in mean performance on only four tasks (Number Conservation, Sibling Egocentrism, Guessing Game, and Object Sorting). On three tasks (Ring Segment, Class Inclusion, and Transitivity), performance is almost identical. Taking a smaller sample of 13 Ss in each I_q group such that the mean mental ages of the groups are more nearly identical (Bright = 7-4; Retarded = 7-5), essentially

the same results are found, with only transitivity moving to the Bright column. Only two of these differences are statistically significant (Magic: t=4.7-, 23 df, p<.001, for equated MA sample; Guessing Game: t=2.31, 24 df, p<.05, for equated MA sample). Taking a frequency count of Ss who are concrete operational on each task, Table 3 indicates a somewhat higher frequency of retardates who are concrete operational, for both unmatched and matched groupings.

Other comparisons of the Bright 5's with retarded and average Ss who are lower in both I_Q and MA show that bright Ss are still lower in mean performance on a number of tasks. Table 4 shows that when Bright 5's were compared with retarded 5's (mean MA=8-3 years) where the Bright 5's have an advantage of 3 months in mean mental age, the High-I_Q group outperforms the Low-I_Q group on only six tasks (Conservation of Mass, Number, Liquid, and Ring Segment, Sibling Egocentrism, and Dream). The Low-I_Q group still outperforms the High-I_Q group on five tasks (Sex Identity, Magic, Left-Right Perspective, Sorting, and Class Inclusion) and performs equally well on four other tasks (Guessing Game, Conservation of Length, Generic Identity, and Transitivity).

Table 4 also shows the results of comparing Bright 5's with Average 6's (mean MA=6-10 years). The higher I_Q and 4-month advantage in mean mental age does the bright group little good. The Average 6's outperform the Bright 5's on seven tasks (Conservation of Mass, Length, and Liquid, Magic, Left-Right Perspective, Sorting, and Guessing Game). The two groups perform equally well on four tasks (Sex Identity, Generic Identity, Dream, and Class Inclusion). The Bright 5's are superior to Average 6's on only four tasks (Sibling Egocentrism, Transitivity, and Conservation of Number and Ring Segment).

The comparisons between Bright groups and groups lower in IQ but equivalent or lower in MA are somewhat equivocal, in light of the general lack of statistically significant differences. However, the consistency of the older groups' superiority on more than half the tasks, and on one-third of the tasks when at a large disadvantage in MA, leads to a serious questioning of the assumption that psychometric and Piagetian tasks reflect the same intelligence. It appears that children of the same psychometric mental age can perform at very different levels on Piagetian tasks, and children of higher IQ can perform at less advanced levels than children of lower IQ. The direction of these findings suggest that it would be fruitful to study the performance of larger group more carefully matched in mental age, and using a retarded group with less variance in chronological age (range here was from 8-9 to 12-5 years).

Only when Bright 6's (mean MA 8-2 years) are compared with Average 7's (mean MA=7-11 years) do we find the higher-IQ group clearly superior. Bright 6's outperform Average 7's on eleven tasks (Conservation of Mass, Number, Length, Liquid, and Ring Segment, Sex Identity, Generic Identity, Magic, Dream, Sibling Egocentrism, and Transitivity). On three tasks (Sorting, Class inclusion, and Guessing Game), the two groups perform at essentially the same level, and on only one task (Left-Right Perspective) is the average group superior. In this comparison, it is clear that High-IQ children become concrete operational at an earlier age than Average-IQ children.

In summary, two results emerge:

1. Children of higher psychometric IQ develop through Piagetian stages faster than children of lower IQ.
2. Prior to the period of concrete operations, high IQ children tend to think in a more preoperational way than older children of the same mental age but lower IQ.

Two conclusions of the study are:

1. Psychometric tests and Piagetian tasks seem to reflect two kinds of intelligence. Piagetian tasks assess basic cognitive structures which are elaborated by the child as he interacts with people and objects in his world. Psychometric tests are composed of items selected on the basis of statistical properties and tap aspects of cognition which are easily measured and which are for the most part rather superficial. This conclusion is supported by factor analytic findings (Kohlberg and DeVries, 1974; DeVries, 1973) which separate psychometric tasks and Piagetian on different factors, and which show Stanford-Binet mental age and certain Piagetian tasks to define a factor separate from, but dependent on, a factor defined by other Piagetian tasks.
2. Experience is an important factor in the development of Piagetian intelligence. The child who has lived longer has had more opportunities for experiences in which he elaborates his cognitive framework. Psychometric mental age alone cannot assess the result of this elaboration.

The basic issue here is what kind of information about an individual's competence is meaningful and of practical value? In the January issue of the American Psychologist, McClelland (1973)

persuasively assesses evidence to support his argument that psychometric intelligence tests are valid only for predicting competence in school achievement. He suggests that these IQ tests should not be labelled for other uses. In addition, he suggests that tests for competence should include measures of thought patterns or codes which apply to a wide range of action possibilities. If McClelland means something like cognitive structure, I would submit that Piaget-type tasks provide meaningful information about an individual's thought patterns which has much more practical utility than psychometric tasks. What do we know about a child's intelligence when we know his psychometric IQ or mental age? How much more do we know about his intelligence when we know he is pre-operational?

Figure 1

Mean Performance of Bright, Average, and Retarded Ss on Fifteen Piaget-Type Tasks

(5, 6, and 7 years refer to CA for Bright and Average Ss, and to MA for Retarded Ss)

Bright= ———
Average= - - - -
Retarded= ..

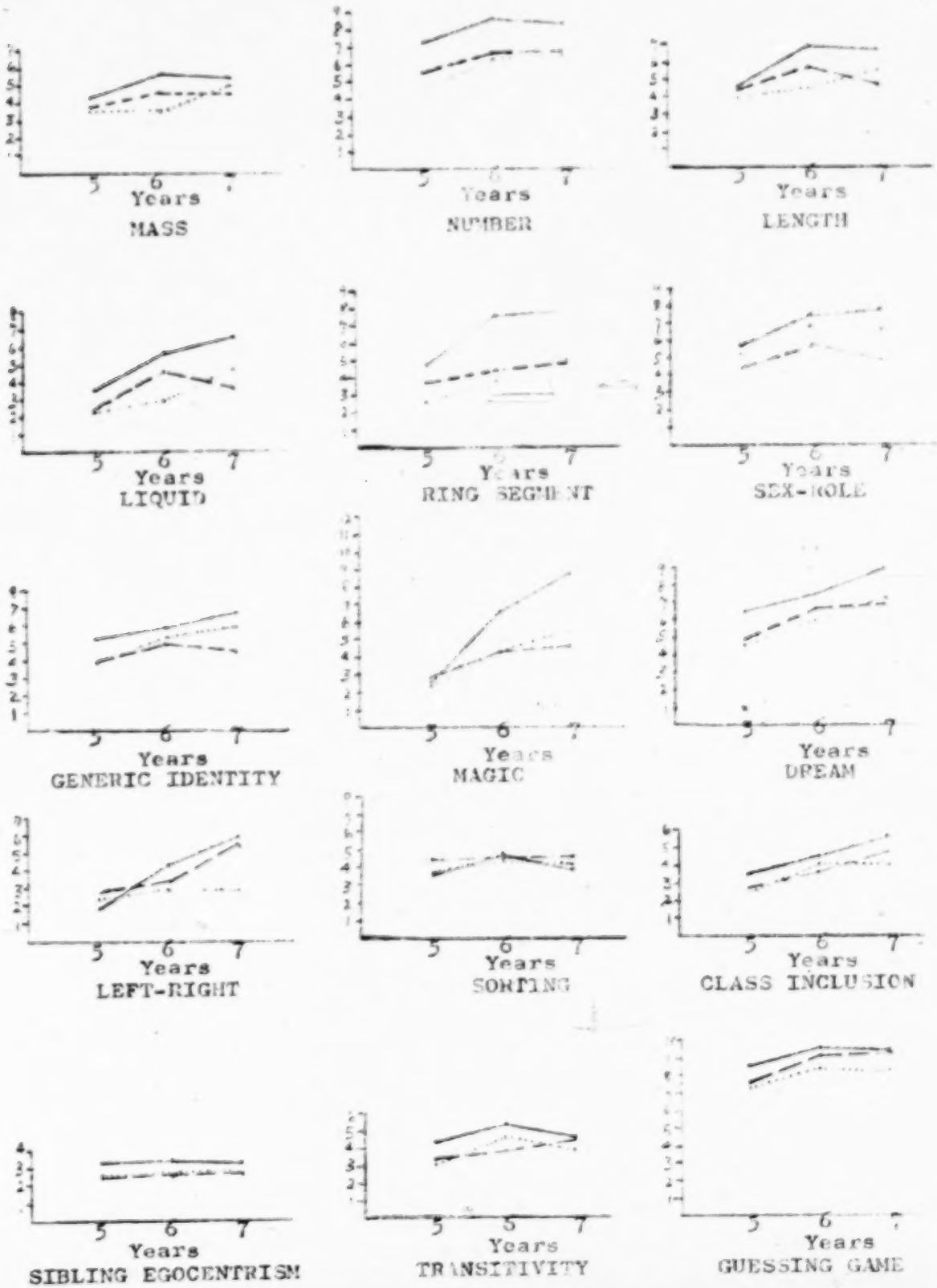

TABLE 1

MEAN CHRONOLOGICAL AGE, MENTAL AGE, AND IQ OF BRIGHT, AVERAGE, AND RETARDED SUBJECTS IN STUDY 1 (N=143)

Age Group	Characteristics	Bright			Average			Retarded[a]		
		Boys	Girls	All	Boys	Girls	All	Boys	Girls	All
5	N	8	8	16	9	8	17	8	5	13
	CA[b]	5-5	5-8	5-7	5-6	5-6	5-6	7-10	7-4	7-8
	MA[b]	6-10	7-5	7-2	5-10	5-9	5-9	5-6	5-3	5-5
	IQ	130	133	132	108	105	106	69	67	68
6	N	8	8	16	8	9	17	8	8	16
	CA[b]	6-6	6-6	6-6	6-7	6-5	6-6	8-6	8-9	8-7
	MA[b]	8-2	8-2	8-2	6-10	6-11	6-10	6-4	6-5	6-5
	IQ	129	129	129	104	107	105	74	72	73
7	N	8	8	16	8	8	16	8	8	16
	CA[b]	7-7	7-7	7-7	7-9	7-7	7-8	9-11	10-1	10-0
	MA[b]	9-8	9-9	9-9	7-11	7-11	7-11	7-5	7-6	7-6
	IQ	130	130	130	101	105	103	75	74	75
Mean All Ages	N	24	24	48	25	25	50	24	21	45
	CA[b]	6-6	6-7	6-7	6-7	6-6	6-6	8-9	8-11	8-10
	MA[b]	8-3	8-5	8-4	6-10	6-10	6-10	6-5	6-7	6-6
	IQ	130	131	130	104	105	105	72	72	72

[a]Age group classification for this group is mental age, rather than chronological age.

[b]Years and months.

TABLE 2

Analysis of Variance of Bright vs. Average Groups

	IQ	SEX	AGE	SEX X CA	SEX X IQ	CA X IQ	SEX CA X IQ
Mass Conservation	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
Number Conservation	.0001	N.S.	.02	.04	N.S.	N.S.	N.S.
Length Conservation	.003	N.S.	.0003	N.S.	N.S.	N.S.	N.S.
Liquid Conservation	.0007	N.S.	.002	N.S.	N.S.	N.S.	N.S.
Ring-Segment Conservation	.0001	N.S.	.0002	N.S.	N.S.	.05	N.S.
Sex-Role Identity	.0003	N.S.	.02	N.S.	N.S.	N.S.	N.S.
Generic Identity	.0001	N.S.	.05	N.S.	N.S.	N.S.	N.S.
Magic	.0001	N.S.	.0001	N.S.	N.S.	.002	N.S.
Dreams	.0001	N.S.	.0001	.02	N.S.	N.S.	N.S.
Left-Right Perspective	N.S.	N.S.	.0001	N.S.	.03	N.S.	.04
Sorting	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
Class Inclusion	.0006	N.S.	.0001	N.S.	N.S.	N.S.	N.S.
Sibling Ego Centrism	.0006	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
Length Transitivity	.002	N.S.	.05	N.S.	N.S.	N.S.	N.S.
Guessing Game	.0001	N.S.	.0001	N.S.	N.S.	N.S.	N.S.

TABLE 3

Analysis of Variance ofAverage vs. Retarded Groups

	IQ	SEX	AGE	SEX XIQ	SEX XIQ	CA XIQ	SEX CAXIQ
Mass Conservation	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
Number Conservation	N.S.	N.S.	.03	N.S.	N.S.	N.S.	N.S.
Length Conservation	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
Liquid Conservation	N.S.	N.S.	.008	N.S.	N S.	N.S.	N.S.
Ring-Segment Conservation	N.S.	N.S.	.01	N.S.	N.S.	N.S.	N.S.
Sex-Role Identity	.03	N.S.	.05	N.S.	N.S.	N.S.	N.S.
Generic Identity	N.S.	N.S.	.03	N.S.	N.S.	N.S.	N.S.
Magic	N.S.	N.S.	.0009	N.S.	N.S.	N.S.	N.S.
Dreams	N.S.	N.S.	.0005	N.S.	N.S.	N.S.	N.S.
Left-Right Perspective	N.S.	.03	.001	N.S.	N.S.	.02	N.S.
Sorting	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
Class Inclusion	N.S.	N.S.	.0001	N.S.	N.S.	N.S.	N.S
Sibling Ego Centrism	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
Length Transitivity	N.S.	N.S.	.01	N.S.	N.S.	N.S.	N.S.
Guessing Game	.005	N.S.	.0005	N.S.	N.S.	N.S.	N.S.

TABLE 4

COMPARISON OF SEVERAL MENTAL-AGE GROUPS

ON PIAGETIAN TASK PERFORMANCE

Bright 5's (MA=7-2 years) Superior on:	Two groups are same on:	Retarded 7's (MA=7-6 years) superior on:
Number	Ring Segment	
Sibling Egocentrism	Class Inclusion	Mass
Guessing Game	Transitivity	Length
Object sorting		Sex Identity
		Generic Identity
		Magic
		Dream
		Left-Right Perspective

Bright 5's (MA=7-2 years) Superior on:	Two Groups same on:	Retarded 6's (MA=6-5 years) Superior on:
Mass	Guessing Game	
Number	Length	Sex Identity
Sibling Egocentrism	Generic Identity	Magic
Liquid	Transitivity	Left-right Perspective
Ring Segment		Sorting
Dream		Class Inclusion

Bright 5's (MA=7-2 years) superior on:	Two groups same on:	Average 6's (MA=6-10 years) superior on:
Sibling Egocentrism	Sex Identity	Mass
Transitivity	Generic Identity	Length
Number	Dream	Liquid
Ring Segment	Class Inclusion	Magic
		Left-Right Perspective
		Sorting
		Guessing Game

TABLE 4 con't

Comparison of Several Mental-Age Groups
on Piagetian Tadk Performance

Bright 6's (MA=8-2 years) superion on:	Two groups same on:	Average 7's (MA=7-11 years) superior on:
Mass	Sorting	Left-Right Perspective
Number	Class Inclusion	
Length	Guessing Game	
Liquid		
Ring Segment		
Sex Identity		
Generic Identity		
Magic		
Dream		
Sibling Ego Centrism		
Transitivity		

Table 3

Frequency of Bright 7's and Retarded 7's
Who Are Concrete Operational on 13 Piaget-Type Tasks

Task	Bright 7's		Retarded 7's	
	N=10 MA=7-2	N=13 MA=7-1	N=10 MA=7-6	N=13 MA=7-7
Guessing Game	10	10	7	5
Sibling Egocentrism	10	8	7	6
Generic Identity	4	4	6	5
Left-Right Perspective	0	0	1	1
Conservation of Mass	3	4	8	6
Conservation of Number	10	10	9	8
Sex Identity	5	5	7	6
Class Inclusion	2	1	2	2
Conservation of Liquid	5	5	7	6
Conservation of Length	5	4	11	8
Magic	0	0	2	2
Transitivity	5	5	5	5
Ring Segment	2	2	2	2
Object Sorting	5	5	2	2
Dream	8	6	9	8